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(71) Applicant(s)
The Drum Engineering Company Limited

(Incorporated in the United Kingdom)

PO Box 468, Cross Lane, Tong, BRADFORD, West Yorkshire, BD4 0SU, United Kingdom

(72) Inventor(s)
Benjamin Martin

(74) Agent and/or Address for Service
W P Thompson & Co
Coopers Building, Church Street, LIVERPOOL, L1 3AB, United Kingdom

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GB 2260424 A EP 0440299 A1
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UK CL (Edition N) G3N NGK2 NGL
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(54) Unloading system for a tanker

(57) A tanker valve control system 5 for regulating the unloading of cargo from a tanker into storage tanks 9 and preventing spillage or "cross overs" (in which, due to incorrect connection of hoses, cargoes are delivered to the wrong storage tank) is disclosed. The system comprises a radio link via which data can be exchanged with a tank controller 32 monitoring the storage tanks 9, thereby allowing cross over detection without any need for electrical connection along a delivery hose.

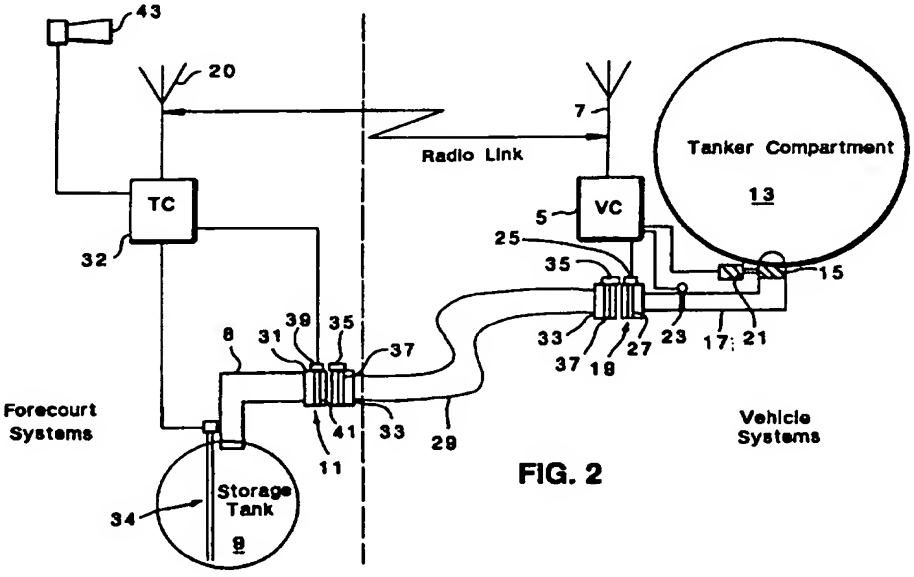

FIG. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

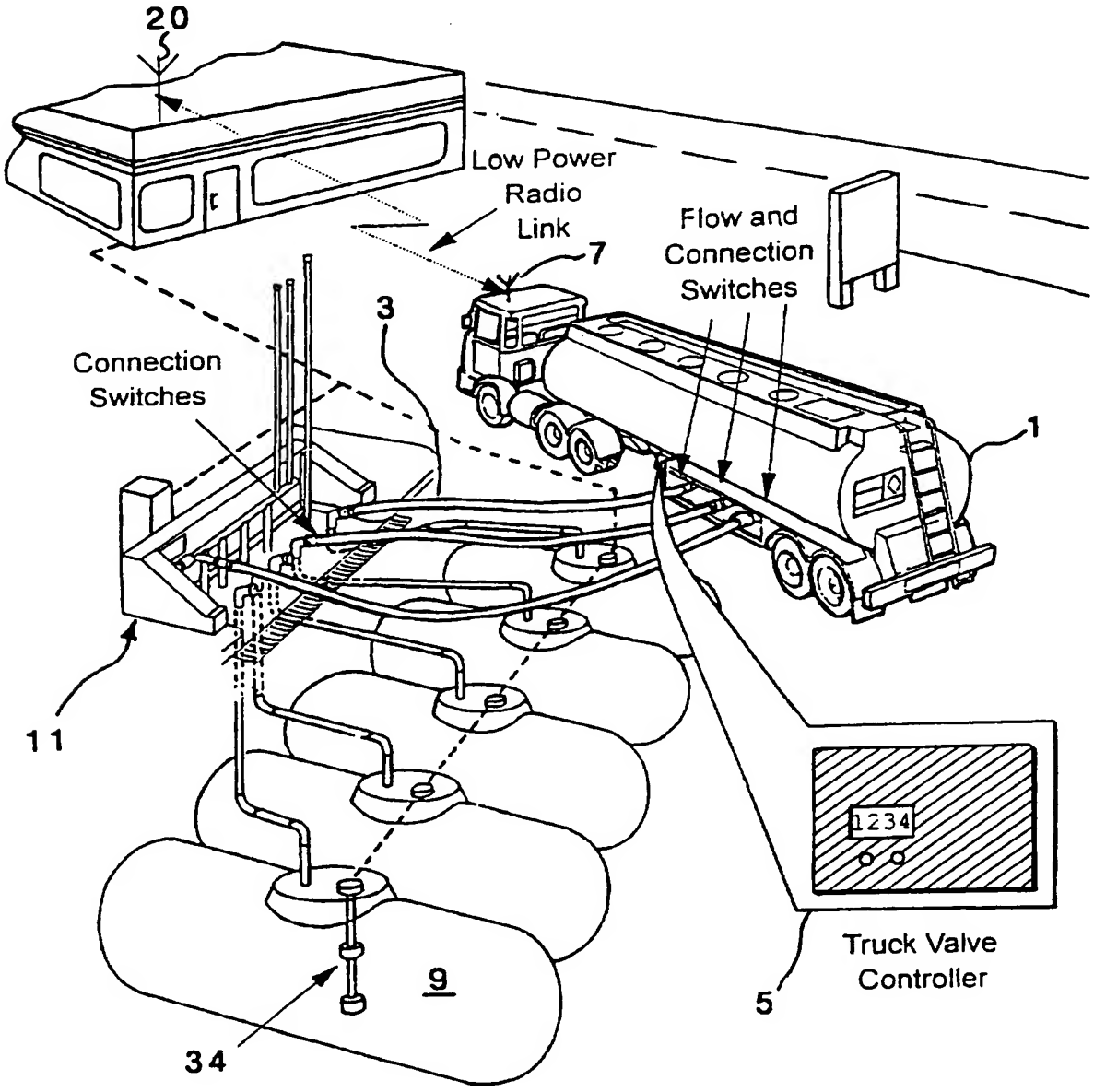
20
Low Power
Radio
Link
7
Flow and
Connection
Switches
3
Connection
Switches
1
11
1234
Truck Valve
Controller
5
9
34

FIG. 1

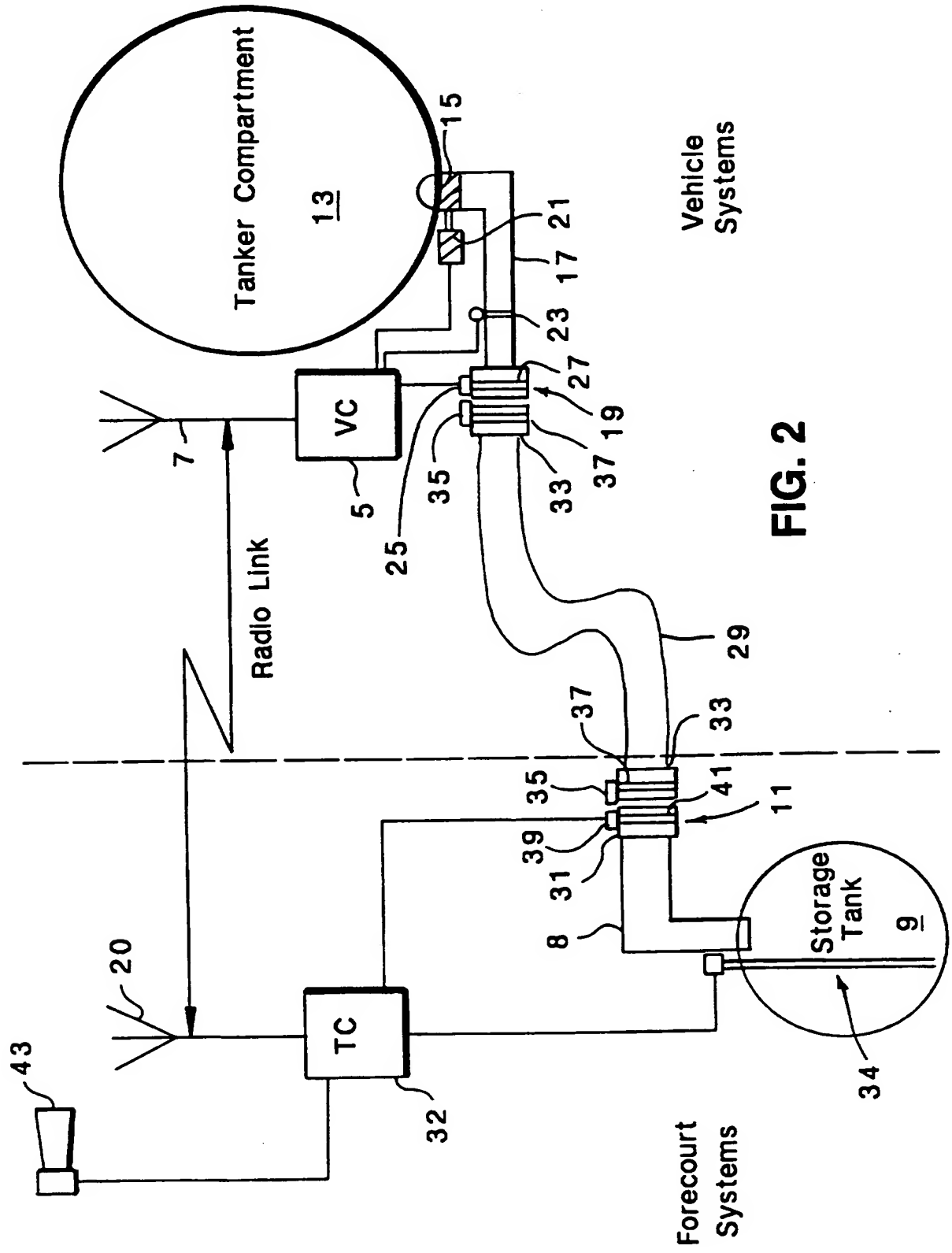
Tanker Compartment
13
15
21
17
23
27
19
37
33
29
Vehicle Systems
VC
5
7
25
35
Radio Link
37
33
35
41
11
39
31
8
Storage Tank
9
20
TC
43
32
34
Forecourt Systems

FIG. 2

DESCRIPTION

UNLOADING SYSTEM FOR A TANKER

The present invention is concerned with the unloading of tankers, for example the unloading of petroleum or autodiesel from a road tanker into an underground storage tank.

Tankers such as road tankers carrying liquid cargoes are conventionally unloaded via at least one hose. An important example is petrol/diesel tankers, which are unloaded via a hose into underground storage tanks at a filling station.

Since there are typically several underground storage tanks containing respective fuels, an important problem can arise where (due to human error) a tanker compartment containing a particular fuel is connected to a storage tank containing a different fuel. Such "cross overs" cause mixing of fuel and can necessitate expensive flushing of storage tanks.

The process of unloading such tankers can even be hazardous if human error leads to connections between the storage tank, the tanker and the hose being made in the wrong order, with consequent spillage of cargo.

An object of the present invention is to provide a control system for regulating the unloading of a tanker into one or more storage tank(s), wherein incorrect connection of the storage tank, the tanker

and the hose is prevented.

In particular, it is an object of the present invention to provide an unloading system capable of preventing cross overs, i.e. unloading of cargo into the wrong tank, which can cause mixing of cargoes, leading to wastage and necessitating expensive corrective measures.

Still another object of the present invention is to provide such an unloading system which does not require electrical connections from the tanker to the storage tank installation.

Cross over prevention systems are known which rely on the establishment of an electrical connection along the hose through which the product is unloaded, but there are problems associated with these known devices:

i. the hoses used must be specially designed;

ii. insulated fixed connectors are required on the filling station forecourt and the tanker;

iii. in view of the fire risk with flammable cargoes, the electrical signals must be of an intrinsically safe type (in particular, the potential must be low). Damp conditions or other circumstances such as degradation of contacts may prevent adequate electrical contact being made upon connection of the hose.

In accordance with the present invention, there is provided a tanker valve controller (TVC) which comprises or is connected to a radio, and is adapted to be connected to a sensor monitoring a tanker compartment and a control valve associated with said tanker compartment, the TVC being adapted to receive data from the sensor and, via the radio, from a tank controller monitoring a storage tank installation, and to control the valve in dependence on the data received.

Preferably, the TVC is adapted to receive planned delivery data from an on truck computer system.

In a preferred embodiment, the TVC is adapted to receive and store data concerning storage tanks from a tank controller via the radio.

In a further preferred embodiment, said received data is compared with planned delivery data to ensure that the planned delivery can take place without spillage and/or mixing of products. This function may be performed by the TVC or, more preferably, by an on truck computer system to which the TVC is connected.

In accordance with another aspect of the present invention, there is provided a tanker valve control system comprising a TVC as described above, and a sensor adapted to be mounted at an output of a tanker compartment and to detect when a connection is made to

said output, the sensor being connected to the TVC.

Preferably said sensor is in the form of a switch whose state is changed upon connection of a hose to the output of the tanker compartment.

The TVC is preferably adapted to retain said control valve in a closed state until the TVC receives a signal from the storage tank controller indicating that a connection has been made to a storage tank, followed by a signal from said sensor indicating that a connection has been made to the tanker compartment.

The tanker valve control system may, in accordance with the present invention further comprise a flow sensor, connected to the TVC and adapted to detect flow out of said tanker compartment.

The TVC is preferably adapted to receive data regarding the flow of cargo into a storage tank from the tank controller via the radio, and to receive data regarding the flow of cargo out of the tanker compartment from the flow sensor, and to close the control valve if there is a mismatch.

In accordance with still another aspect of the present invention, there is provided a system for regulating the unloading of a tanker, comprising a tanker valve controller connected to a sensor for monitoring a tanker compartment and to an isolating valve of said tanker compartment, and a storage tank

controller adapted to monitor a storage tank installation, the tanker valve controller and the storage tank controller being adapted to exchange data via a radio link.

In accordance with yet another aspect of the present invention, there is provided a system for regulating the unloading of cargo from a tanker into one or more storage tanks, comprising a radio link between a tanker valve controller and electronic means associated with a storage tank fill point, at least one switch, which is connected to said electronic means associated with the storage tank fill point and whose state is altered upon connection of a hose to a connector at the storage tank fill point and is communicated via the radio link to the tanker valve controller, at least one switch at the tanker, whose state is altered upon connection of a hose to a connector at the tanker and is communicated to the tanker valve controller, at least one flow monitor at the tanker arranged to detect a flow of liquid out of the tanker and connected to the tanker valve controller, and at least one valve at the tanker which is connected to the tanker valve controller, the tanker valve controller being arranged to maintain said valve in a closed state, preventing flow of cargo out of at least one compartment of the tanker, if a

proper sequence of connection is not followed.

Such a tanker valve controller may, in accordance with the present invention, be arranged to close said valve if the product in the compartment of the tanker being emptied is not the same as the product in the storage tank.

In accordance with still a further aspect of the present invention, there is provided a system for controlling the unloading of a tanker, which is adapted to maintain a control valve associated with a tanker compartment in a closed state unless the following sequence of operations is observed:-

connection of one end of a delivery hose to a storage tank fill point;

connection of the other end of the delivery hose to the tanker compartment faucet.

Preferably, the control valve is maintained in the closed state unless the tanker compartment faucet is opened after connection of the delivery hose thereto.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a stylised perspective view of a tanker being unloaded at a filling station forecourt, using a

system in accordance with the present invention; and

Fig. 2 is a schematic representation of an unloading system in accordance with the present invention.

The illustrated embodiment of the invention comprises a newly-developed electronic "valve controller" (VC) system designed to allow Driver Controlled Delivery (DCD) of bulk quantities of petroleum or other liquid products from a road tanker to a storage facility such as a filling station forecourt. The system receives planned delivery data from an existing On-Truck Computer (OTC) system and communicates with the forecourt gauging systems by means of a Low Power Radio (LPR) telemetry link.

During a delivery, the VC monitors the flow of product from the tanker storage compartments by means of suitably installed flow switches, and looks for a corresponding rise in the level of the forecourt tanks as signalled over the LPR link. Should a fault of any kind occur, the VC will automatically cut off the delivery through the medium of electrically-actuated pneumatic solenoids.

The VC hardware according to the present embodiment of the invention is based around an especially designed reprogrammable microcomputer system, and provides for many more electrical sensor

inputs, and electrical outputs to control solenoids, than the basic DCD function requires. The system exploits these additional inputs and outputs, and the hardware's inherent reprogrammability, to analyse additional data available over the LPR link to enforce a correct means of working that will automatically eliminate any risk of one product type being delivered into a tank containing, or designated to contain, a second type. It will thus provide all the features necessary to act as a "Cross-Over Prevention" (COP) system.

To consider the illustrated embodiment in more detail, Fig. 1 shows a tanker 1 linked to storage tanks at a filling station forecourt by hoses 3.

The tanker 1 is provided with a tanker valve controller 5 which comprises a low power radio with an aerial 7.

Referring to Fig. 2, each tanker compartment 13 is connected (as standard) to a foot valve 15 which in turn is connected by a rigid pipe 17 to a faucet 19, which must be opened to allow delivery. The foot valve allows or prevents the release of petroleum product from the compartment and is operated via a pneumatic solenoid 21, which is, in turn, permitted to operate under the control of intrinsically safe electrical signals from the VC equipment 5. Thus,

while the signal to open the foot valve 15 will normally be given via manually operated controls, the foot valve will not open until released to do so by the valve controller. For each compartment, the VC also receives electrical signals from a flow switch 23 and a "hose connected" switch 25, the switching status of these two devices indicates, respectively, that flow is taking place in the rigid pipe 17 and that a hose is connected to the faucet. The flow switch 23 is inserted permanently into the pipe 17, whilst the hose connected switch is mechanically secured by a clamp 27 directly to the outside of the faucet adaptor, which can therefore be of a conventional type.

Turning now to the forecourt equipment, fuel is stored in underground storage tanks 9 which are connected by fill pipes 8 to a tank fill point 11. The fill pipes 8 terminate in hose connection points 31 at the fill point 11.

Of course, while Fig. 2 shows only one compartment 13, storage tank 9 and connections therebetween, a real system typically includes a plurality of these, as in Fig. 1.

A standard delivery hose 29 is used to connect the faucet 19 of the tanker to the hose connection points 31 at the fill point 11 and so to the

underground storage tank 9. The standard connectors 33 at each end of the hose are fitted with respective mechanical levers 35 attached by means of respective clamps 37 designed so as to operate the hose connected switch 25 on the faucet and a similar hose connected switch 39 mechanically secured using a clamp 41 to the fill pipe 8. In each case, the switches are so arranged as to only indicate proper connection when the hose is fully and correctly connected to the relevant faucet or hose connection point.

The electrical signal from each storage tank hose connected switch is passed on to a forecourt "Tank Controller" (TC) system 32, which also receives storage tank ullage and other data from a contents probe 34. The VC 5 and TC 32 comprise similar low power radio equipment 7,20 and communicate data about all aspects of the planned and actual delivery process over the short range, low power radio data link.

The sequence of operation of such a system would be as follows:

a. The tanker 1 would enter the filling station forecourt, park, and establish a satisfactory connection of the low power radio (LPR) link.

b. The VC 5 would interrogate the forecourt systems via the LPR link to determine the number of tanks 9 on the forecourt, their capacities, the

product type(s) they hold and the ullage of each tank.

c. By one of a number of methods not germane to this application, the truck driver would enter his delivery plan - the product types and quantities to be delivered from the tanker to the forecourt - into his on truck computer (OTC) system.

d. The delivery data would be compared with the forecourt data received at item "b" above, product types would be allocated for delivery to specific forecourt tanks, and the vehicle OTC system would confirm that the delivery could safely take place - essentially that the appropriate tanks contained sufficient ullage to accept the planned delivery.

e. Having confirmed that the delivery plan was acceptable, the driver would leave his vehicle and turn off his Master Switch, leaving the VC 5 and its associated LPR running on internal battery power.

f. The driver would then begin the delivery of product from the first compartment on his vehicle to the designated storage tank by making connections in the following sequence:

i. Connect one end of a delivery hose to the hose connection point 31 of the storage tank fill point 11.

ii. Connect the other end of the hose to the tank compartment faucet 19.

iii. Open the faucet 19 to allow the delivery to begin.

g. Through the medium of the switches 39,25 on the fill point and faucet - with the former transferring data to the vehicle via the LPR link - and through the flow switch 23 actuated by product flow in the compartment output line 17, the VC 5 would monitor these actions. Unless the hose was connected in the correct sequence between a tank/compartment pair with matching product grade, the VC would not provide the electrical signal to the compartment foot valve solenoid 21 to allow the flow to begin. If connections are correctly made between the storage tank and the tanker compartment, the footvalve is released, and flow is registered. if connections are incorrectly made, and therefore the footvalve does not open, the driver may have opened the faucet, which constitutes a potentially hazardous situation. An interlock may be provided to prevent loss of fluid cargo. Only when flow has been registered can the driver then proceed to the next stage.

h. Once flow had been correctly established between a compartment and its matching storage tank, the VC 5 would monitor the connection of a second hose, again only permitting flow to take place if the hose was correctly connected in the proper sequence.

This process could be repeated with subsequent tank/compartment pairs.

The VC 5 is arranged to monitor the progress of a delivery in the manner described above. In addition to ensuring that the correct delivery procedures are enforced, it is capable of monitoring the product level in the storage tank as it fills by means of data transmitted over the LPR link from the contents probe 34 via the TC 32. Should the level of the contents probe indicate that the storage tank is about to overfill for any reason, the VC 5 will be able to cancel all product flow by closing the relevant compartment foot valve 15. In such an event, or in certain other cases, the VC is capable of sending a radio signal to the TC to instruct the latter to sound a forecourt emergency alarm 43.

To understand one way in which the present invention can be used to guard against incorrect connection, suppose that the driver connects one end of a hose "A" to a storage tank, No. 2. Then he connects one end of another hose "B" to a tanker compartment 4. If then he connects the other end of hose "A" to, say, a tanker compartment No. 3 and the other end of hose "B" to, say, a storage tank No. 5, (i.e. the delivery plan wanted is storage tank No. 2 to tanker compartment No. 4 and storage tank No. 5 to

tanker compartment No. 3 but actually the driver connected storage tank No. 2 to tanker compartment No. 3 and storage tank No. 5 to tanker compartment No. 4).

Under these circumstances, the logic of operation would have been violated since flow did not commence after the sequence of:

(i) storage tank connection, and

(ii) tanker compartment connection.

If flow is then not registered, as in this case, the VC 5 may be arranged to ensure that the footvalves on all compartments not currently registering flow will be locked shut, and the driver must then disconnect all hoses such that all connectors without flow have an unswitched status before the valves are released. Then he can restart the:

(i) storage tank connection

(ii) tanker compartment connection

(iii) open valve (register flow) sequence.

The system in accordance with the present invention therefore ensures that the proper sequence of connections is followed without requiring any electrical connection between the tanker and the tank fill point.

The present invention makes possible the following advantages:

a. It can eliminate the risk of Cross-Over

errors and their associated high cost of correction for oil companies.

b. It can utilise existing equipment, both electronic and mechanical, fitted to trucks.

c. By permitting the use of hoses to the current, extremely robust, standard design, and which are not required to act as reliable carriers of low-level, Intrinsically Safe, data signals, it reduces the risk of physical damage preventing its operation. It is also be capable of operation in circumstances, such as damp conditions and crossed hoses, which can interfere with other COP systems.

d. It requires the minimum of modification to existing systems, such as truck faucets and storage tank fill pipes.

e. It avoids the need for electrically isolated faucets, thus avoiding the risk of a build up of electrical charge on isolated conductive materials.

CLAIMS

1. A tanker valve controller (TVC) which comprises or is connected to a radio, and is adapted to be connected to a sensor monitoring a tanker compartment and a control valve associated with said tanker compartment, the TVC being adapted to receive data from the sensor and, via the radio, from a tank controller monitoring a storage tank installation, and to control the valve in dependence on the data received.

2. A TVC as claimed in claim 1, adapted to receive planned delivery data from an on truck computer system.

3. A TVC as claimed in claim 1 or claim 2, adapted to receive and store data concerning storage tanks from a tank controller via the radio.

4. A tanker valve control system comprising a TVC as claimed in any preceding claim, and a sensor adapted to be mounted at an output of a tanker compartment and to detect when a connection is made to said output, the sensor being connected to the TVC.

5. A tanker valve control system as claimed in claim 4, wherein said received data is compared with planned delivery data to ensure that the planned delivery can take place without spillage and/or mixing of products.

6. A tanker valve control system as claimed in claim 5, wherein said comparison of received data with planned delivery data is performed by an on truck computer system connected to the TVC.

7. A tanker valve control system as claimed in any of claims 4,5, and 6, wherein said sensor is in the form of a switch whose state is changed upon connection of a hose to the output of the tanker compartment.

8. A tanker valve control system as claimed in any of claims 4 to 7, wherein the TVC is adapted to retain said control valve in a closed state until the TVC receives a signal from the storage tank controller indicating that a connection has been made to a storage tank, followed by a signal from said sensor indicating that a connection has been made to the tanker compartment.

9. A tanker valve control system as claimed in any of claims 4 to 8, comprising a flow sensor, connected to the TVC and adapted to detect flow out of said tanker compartment.

10. A tanker valve control system as claimed in claim 9, wherein the TVC is adapted to receive data regarding the flow of cargo into a storage tank from the tank controller via the radio, and to receive data regarding the flow of cargo out of the tanker

compartment from the flow sensor, and to close the control valve if there is a mismatch.

11. A system for regulating the unloading of a tanker, comprising a tanker valve controller connected to a sensor for monitoring a tanker compartment and to an isolating valve of said tanker compartment, and a storage tank controller adapted to monitor a storage tank installation, the tanker valve controller and the storage tank controller being adapted to exchange data via a radio link.

12. A system for regulating the unloading of cargo from a tanker into one or more storage tanks, comprising a radio link between a tanker valve controller and electronic means associated with a storage tank fill point, at least one switch, which is connected to said electronic means associated with the storage tank fill point and whose state is altered upon connection of a hose to a connector at the storage tank fill point and is communicated via the radio link to the tanker valve controller, at least one switch at the tanker, whose state is altered upon connection of a hose to a connector at the tanker and is communicated to the tanker valve controller, at least one flow monitor at the tanker arranged to detect a flow of liquid out of the tanker and connected to the tanker valve controller, and at least

one valve at the tanker which is connected to the tanker valve controller, the tanker valve controller being arranged to maintain said valve in a closed state, preventing flow of cargo out of at least one compartment of the tanker, if a proper sequence of connection is not followed.

13. A tanker valve controller as claimed in claim 12, arranged to close said valve if the product in the compartment of the tanker being emptied is not the same as the product in the storage tank.

14. A system for controlling the unloading of a tanker, which is adapted to maintain a control valve associated with a tanker compartment in a closed state unless the following sequence of operations is observed:-

connection of one end of a delivery hose to a storage tank fill point;

connection of the other end of the delivery hose to the tanker compartment faucet.

15. A system as claimed in claim 14, wherein the control valve is maintained in the closed state unless the tanker compartment faucet is opened after connection of the delivery hose thereto.

16. A tanker valve controller substantially as described herein with reference to, and as illustrated in, the accompanying drawings.

17. A tanker valve control system substantially as described herein with reference to, and as illustrated in, the accompanying drawings.

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Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9518795.1
Relevant Technical Fields (i) UK Cl (Ed.N) G3N (NGL, NGK2) (ii) Int Cl (Ed.6) B67D (5/32)	Search Examiner MR D A SIMPSON Date of completion of Search 25 OCTOBER 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) WPI	Documents considered relevant following a search in respect of Claims :- 1 to 13 and 16

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X,Y	GB 2260424 A	(WATERTEC) page 13 line 21 to page 15 line 11	1, 3 and 11
Y	EP 0440299 A1	(SHELL) column 3 lines 1 to 52	1, 3 and 11
Y	WPI Abstract Accession No 91-243862/33 & SE 466014 B (HERCULES) see Abstract		1, 3 and 11

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